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Will the regional concentration of tertiary education persist? The case of Europe in a period of rising participation

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ABSTRACT

The economic impact of tertiary education is important for regional development, and whilst participation rates have increased, it is unclear whether this has benefited regions equally. The paper analyses a panel of European regions to determine how the geography of tertiary education has evolved between 2002 and 2012. The results show a mixed picture. Overall, the system is characterized by path dependency, with the past being the best predictor of the future. There are some signs that the most lagging regions in 2002 are catching up, with some benefiting from recently opened institutions. Meanwhile, the very top-performing regions are breaking away from the rest, showing above-average growth, especially in the case capital regions. This work contributes to the ongoing research on the role of higher education in fostering regional economic development, and the emerging inequalities across European regions.

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INTRODUCTION

This paper examines the regional distribution of tertiary education (TE) in Europe with the aim of identifying whether recent growth of the sector has served to promote equitable geographical distribution or if it has entrenched existing centres of excellence. As we review in the next section, a large evidence base documents the diverse channels through which the activities of tertiary education[1] institutions (TEIs) benefit their host regional economies. As a result, governments have sometimes taken explicit steps to decentralize the provision of TE in order to achieve regional policy aims (e.g., Andersson, Quigley, & Wilhelmson, 2004, for the case of Sweden). However, there are ongoing concerns about regional inequality in TE activity, which has crystalized in debates about the primacy of equity or excellence in European science funding (see The Guild

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of European Research-Intensive Universities, 2018, for an overview). The recent rise in political extremism (Rodríguez-Pose, 2018) lends these debates urgency, as although in a global context the European Union (EU) is a club of advanced economies, stark cross-country (e.g., Bartkowska & Riedl, 2012; Prutvot, Estermann, & Kupriyanova, 2017) and intra-country (e.g., Gardiner, Martin, Sunley, & Tyler, 2013) differences persist (OECD, 2017).

Long-term trends in participation rates follow an upward tendency (Jöns & Hoyler, 2013; Lee & Lee, 2016) and the recent history of the EU is no exception (e.g., Brooks, 2018). Over the decade from 2002 to 2012, the TE sector in the average European region expanded by about 30%. Academically, this is an interesting case to examine as it is not clear a priori how the geography of TE should evolve. In terms of its input structure education is an extreme case, relying almost solely on value added (labour, capital), in contrast to manufacturing sectors, which are dependent on intermediate inputs and therefore often cluster geographically around particular supply-chains or natural resources. In terms of final demand, TE relies heavily on public sector funding (although by no means entirely; Hermannsson, Lisenkova, McGregor, & Swales, 2014), and therefore should be sensitive to the priorities of public policy. Following this logic, TE is prima face an ideal economic development tool, offering the possibility of directing activities with significant local economic impacts to lagging regions. Conversely, it is likely to favour the same location amenities as other knowledge-intensive sectors (Saxenian, 1996; Viladecans-Marsal & Arauzo-Carod, 2012; Wenting, Atzema, & Frenken, 2011), and there is some evidence to suggest students prefer to study in economically buoyant regions (Dotti, Fratesi, Lenzi, & Percoco, 2013). These characteristics of TE could make it similar to other knowledge industries, where local 'buzz' and branding reinforce existing paths of agglomeration (Bathelt, Malmberg, & Maskell, 2004).

To address these issues, we construct a macro-panel of European NUTS-2 (and NUTS-1) regions between 2002 and 2012. We examine regional TE enrolment ratios, accounting for both local and incoming students, combined with a range of indicators on local economic and social context. Overall, The results reveal a pattern of path dependency, with the strongest predictor of success being past success. However, this is not a uniform picture. There are signs of catch up as lagging regions exhibit above-average growth and regions with high regional tertiary enrolment ratios (RTERs) are showing signs of saturation with no or negative growth on average. Conversely, there are also signs of divergence, where the regions with the highest enrolment ratios, that is, those that are already successful at attracting mobile students exhibit accelerating growth. Therefore, we conclude that whilst low-level regions are catching up and high-level regions are mostly stagnant, the very top regions appear to be breaking away from the rest. These trends parallel those of income dynamics globally (Alvaredo, Chancel, Piketty, Saez, & Zucman, 2018; Milanovic, 2013), and are consistent with the recent literature focussing on overall economic performance of EU regions (e.g., Iammaringo, Rodriguez-Pose, & Storper, 2018), where a few highly developed and innovative regions have been identified as outperforming most other regions.

The paper is structured as follows. The next section provides a brief summary of the wide-ranging literatures on the local economic impact of TE. The construction of the data set and choice of analytical methods are outlined in the third section. The fourth section describes the levels and changes in regional tertiary enrolment across 2002 and 2012. The fifth section analyses the strength of inter-temporal persistence in tertiary enrolment and explores what other factors play a role in driving change. Brief conclusions are provided in the sixth section.

LITERATURE REVIEW: REGIONAL ECONOMIC DEVELOPMENT AND TERTIARY EDUCATION

There is a large and diverse literature on the regional economic impact of TE. For an overview of the academic literature,[2] see Florax (1992), Drucker and Goldstein (2007), Goldstein (2009),

Hermannsson (2016) and Harrison and Turok (2017). This focuses mainly on higher education, but to a lesser extent on further education (e.g., Hermannsson, Lisenkova, Lecca, McGregor, & Swales, 2017). We group studies of these phenomena into three broad categories: those focusing on impact on the demand-side of the economy, the supply-side and on economic geography.

A long tradition in regional economics examines the expenditure impacts of TEIs and their students. From this perspective, TEIs contribute to the local economy by employing staff and purchasing goods and services for their operations (Hermannsson, Lisenkova, McGregor, & Swales, 2013, 2014). Similarly, students are treated as a source of exogenous consumption expenditures in the local economy, somewhat like tourists (Florax, 1992; Hermannsson, McGregor, & Swales, 2018; Love & McNicoll, 1988; Steinacker, 2005). The methodologies used to quantify these impacts in academic research are well established and draw on the principles of national accounting. Furthermore, by their nature, expenditure impacts are closely tied to the location of the TEI, that is, their benefits tend to concentrate within the region of the TEI.

TEIs exert a range of supply-side impacts, enhancing the productive capacity of the local economy. An obvious channel is the human capital of graduates as gauged by higher wages (Blundell, Deardren, & Sianesi, 2005; Bradley & Taylor, 1996; Checchi, 2006; Harmon & Walker, 2003; Hermannsson, Lisenkova, Lecca, Swales, & McGregor, 2014; Psacharopoulos & Patrinos, 2004). Moreover, graduates produce externalities such as on the wages of non-skilled workers (Moretti, 2004a, 2004b). Similarly, it has been argued that the presence of TEIs (Anselin, Varga, & Acs, 1997) and graduates (Faggian & McCann, 2008, 2009) create knowledge externalities in the local economy and boosts innovation. For an overview of this literature, see Acs (2009). Furthermore, a range of wider impacts have been identified such as non-pecuniary benefits for the graduate population itself, such as improved health, marital success, happiness and family outcomes (McMahon, 2004, 2009). This is in addition to potential socioeconomic feedback, such as on crime (Machin, Marie, & Vujić, 2011). For a discussion of the potential local economic impact of such wider benefits, see Hermannsson et al. (2017). Although there is strong evidence to support positive impacts, in principle there is more ambiguity as to the exact magnitude of these effects (McMahon, 2004, 2009).

From a local perspective, an attractive feature of a successful cluster of TEIs is their apparent ability to shape economic geography by drawing into the region and retaining research and development (R&D) activities (Andersson, Gråsjö, & Karlsson, 2009; Jaffe, 1989) and highly skilled workers (Abel & Deitz, 2012; Ahlin, Andersson, & Thulin, 2018; Beeson & Montgomery, 1993; Bound, Groen, Kézdi, & Turner, 2004; Groen, 2004; Winters, 2011). Crucially, unlikely, say, human capital effects, location effects are a zero-sum game where one region's success draws in resources from another.

A lively area of research has been the mobility of students and graduates. Evidence is mixed as to what attracts students to regions and the extent to which they are subsequently retained in the region as graduates. In a study of US graduates, Groen (2004) finds a significant link between studying in a state and working in it, although the magnitude of the impact was quite modest with approximately 10 of every 100 students living in the state of study 10–15 years after graduation. Bound et al. (2004) point out that graduates are quite mobile and find that at a state level in the United States there is only a modest link between production of graduates within a state and the build-up of a graduate workforce. Venhorst, Van Dijk, and Van Wissen (2011) find that in the Netherlands graduate migration is primarily dependent on the spatial distribution of suitable jobs. Based on Italian data, Dotti et al. (2013) argue that local labour markets are major drivers of TE-related migration, and that often the migration decision of both students and graduates is a joint one, with students choosing to study in cities with attractive labour markets for graduates. Conversely, the results of Faggian and McCann (2008) indicate that for the UK the two

decisions are separate with students being drawn to lower living costs in the north, whilst Greater London is the pre-eminent destination for graduates. Evidence from both the UK and the Netherlands suggests migration is selective, with graduates from more selective institutions and courses being more likely to move (Faggian & McCann, 2008, 2009; Venhorst, Van Dijk, & Van Wissen, 2010).

To summarize, a successful TE sector brings immediate benefits through spending in the local economy, can make the region a more attractive location for people and businesses, and can generate long-term benefits through increase in human capital, socioeconomic feedback and spillovers. Because of the overall benefits associated with TE, it is not surprising that this sector has featured prominently in regional policy, and cases of higher education expansion and decentralization have been documented (e.g., Andersson et al., 2004, for the case of Sweden; and Goldstein & Drucker, 2006, for the United States). Similarly, many authors have studied universities as part of particular cities and argue they play a key role as urban developers and anchor institutions (Ehlenz, 2016; Goddard, Coombes, Kempton, & Vallance, 2014; Perry & Wiewel, 2005).

Whilst there is rich evidence on a range of economic impact of TE, these literatures take the geography of the sector as a given and do not attempt to analyse how it has evolved and is likely to evolve, a lacuna we aim to fill.

DATA

The data are obtained from EUROSTAT, which collects data at the NUTS-1 and -2 levels for a range of educational, social and economic indicators. The time span ranges from 2002 to 2012. This encompasses a decade during which higher education in Europe underwent radical changes. Germany, Portugal, Slovenia and the UK do not provide data at the NUTS-2 level (our preferred areal unit of aggregation). For these countries, we use the NUTS-1 level data, which corresponds to larger territorial units (e.g., *Landers* for Germany), an approach previously used in other regional analyses (Copus, 2011).

The main variable of interest is calculated from an indicator produced by EUROSTAT that shows the share of students in each region in relation to the local population. We refer to this as the regional tertiary enrolment ratio (RTER), which we designate for the i-th region as E_i. This ratio is made up of a numerator encompassing the number of students of enrolled in TE programmes (ISCED 5–6) residing in region i (S_i). To control for scale, the regional population in region i aged 20–24 is used as a denominator:

$$E_i = \frac{S_i}{P_i^{20-24}} \tag{1}$$

A benefit of the RTER (E_i) is that it can be obtained for most EU member states. It is an aggregate indicator that can be thought of as a composite of three underlying factors: (1) the regional participation rate; (2) the retention of students locally; and (3) the attractiveness of the region to mobile students. In turn, these factors are affected by various contextual elements and policies, such as amenities, education funding, student grants, labour and housing markets.

A drawback of the data is that it does not reveal the composition of TE students in each region, whether by origin, nature of institution or programme subject. Therefore, an implicit assumption in this analysis is that student numbers can be taken as a proxy for overall activity levels in TE. This is a reasonable assumption at a large spatial scale such as NUTS-2, where each region contains a range of different types of institutions and courses and aggregating across these will reduce variation in research and staffing intensities. Further control variables used in

Table 1. Summary statistics.

Variable	Observations	Mean	SD	Minimum	Maximum
Regional Tertiary Enrolment Ratio, year 2012	260	58.75512	26.40706	6	220.5
Regional Tertiary Enrolment Ratio, year 2002	230	49.90648	21.31634	3.3	137.6
Regional Tertiary Enrolment Ratio, relative change	227	0.2980925	0.7401884	−0.4290865	8
GDP, year 2002	265	9.821788	0.4725397	8.34284	11.58
Population density, year 2002	258	4.985687	1.174152	0.7884574	8.719203
Employment. 25–34, year 2002	245	4.325081	0.1193099	3.7281	4.495355
GDP, relative change	265	0.2986735	0.278558	−0.1116751	1.629921
Unemployment 20–64, relative change	233	0.4101631	0.7982152	−0.654902	3.261905
Life expectancy, relative change	251	−0.0178194	0.2202581	−1	0.0742296
Population Density, relative change	258	0.0346699	0.068857	−0.1555977	0.3181818

the data set are obtained from EUROSTAT. Summary statistics of key variables are provided in Table 1.

TERTIARY ENROLMENT RATIOS ACROSS REGIONS

As can be gauged from the second line of Table 1, RTERs differed widely across the 230 European NUTS-2 regions for which data were available in 2002. For the median region, this is just under 50%, whilst for 90% of regions this is at or below 78%. The highest value is 137.6%, observed for Vienna in Austria, whilst the lowest observation was 3.7%.

Figure 1 shows a visual representation of how tertiary enrolment ratios varied across regions in 2002.

A decade later, in 2012, observations are available for 30 more regions. Whilst in aggregate the RTER has only grown modestly over this 10-year period, from 49.65% in 2002 to 53.65% in 2012, more dramatic changes have occurred at both tails of the distribution. Those regions at the bottom 10th percentile now have a tertiary enrolment ratio of 37.2%, up 13.75 percentage points from 23.45% in 2002. Likewise, those at the top 90th percentile now stand at 89.5%, up 10.85 percentage points from 78.65% in 2002. The biggest change though has occurred among the top-performing regions, as the top 1% of regions has jumped 45.8 percentage points to 151.4% in 2012 and the top-performing region stands at 220.5%.

The geographical distribution of tertiary enrolment in 2012 is mapped in Figure 2. There are now 46 regions where $E_i > 75\%$, many of which are in Eastern and Southern Europe. Notably, the concentration of TE students in the UK has shrunk for most regions, and no region now registers $E_i > 75\%$. This is likely due to tighter visa regulations, which severely restricted opportunities for overseas students enrolling onto short duration courses outwith the formal higher and further education sectors.[3] From Figure 2, we can observe the 'pull' effect of capital regions in this period. This is particularly evidence for Eastern Europe, Mediterranean and Benelux countries, where capital regions grow in excess of national averages.

The scale of change across NUTS-2 regions is further highlighted in Figure 3. With a few exceptions,[4] most notably the UK, most regions exhibit growing tertiary enrolment ratios. A few regions even register growth in excess of 100%. For example, this is the case of Drenthe, Flevoland and Val D'Aosta where the tertiary enrolment was more than five times higher than a decade before. It is interesting to note here that these three regions host relatively new TEIs, either

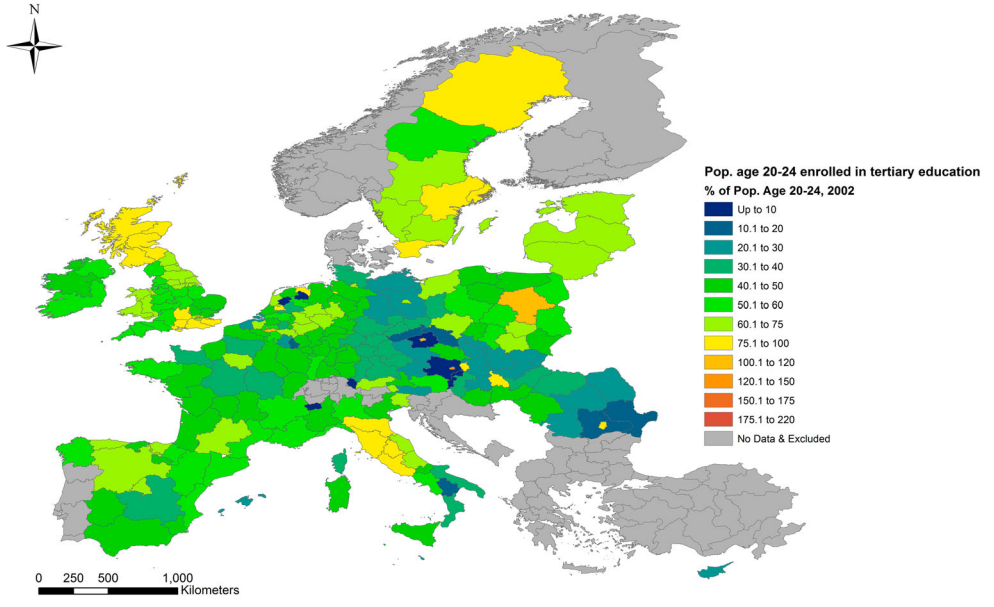

Figure 1. Regional tertiary enrolment ratio (RTER) (E_i) by region in 2002.

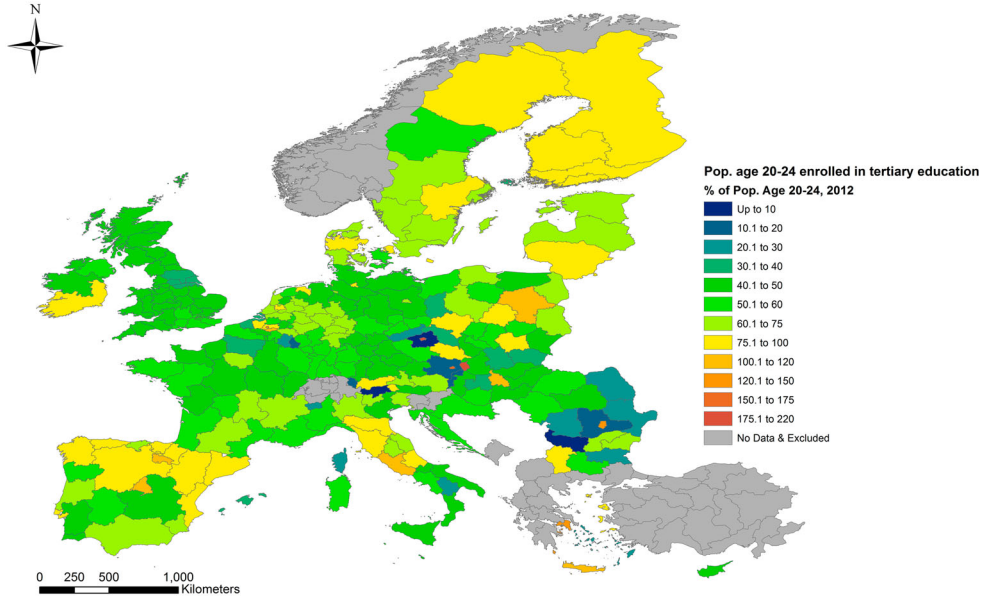

Figure 2. Regional tertiary enrolment ratio (RTER) (E_i) by region in 2012.

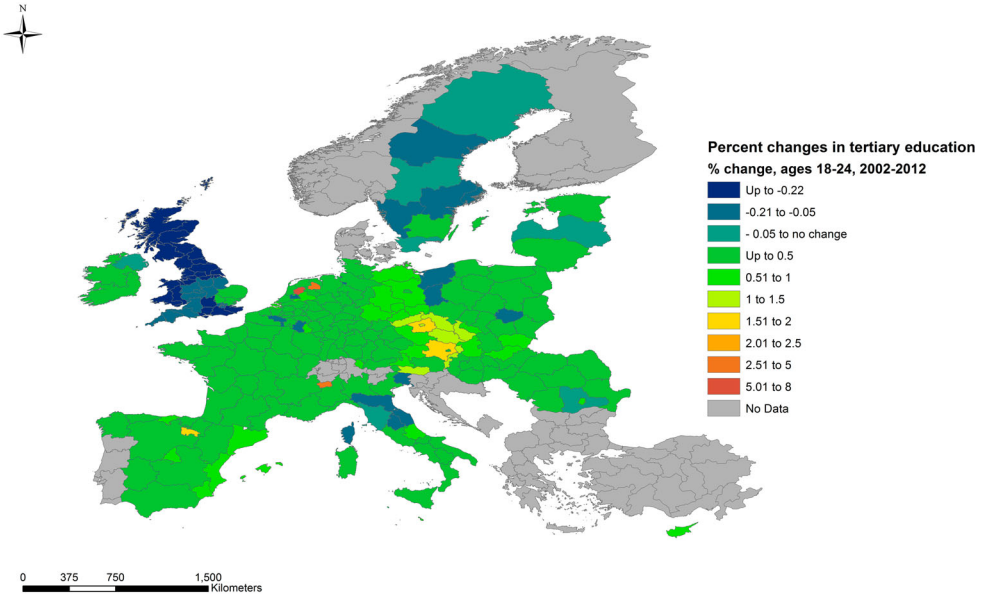

Figure 3. Percentage change in enrolment ratio (E_i) by region between 2002 and 2012.

created through merging and expanding previously existing institutions (in Flevoland in 1986 and in Drenthe in 2008), or through the establishment of brand new universities (e.g., in Val d'Aosta in 2000). The data presented in Figures 1–3 are available in the online appendix.

Table 2 provides summary statistics for levels and growth for each country, inversely ranked by growth rate. Average enrolment has decreased for three countries: the UK, Sweden and Latvia, whilst the remaining 25 countries register growth mostly below 1%. The biggest change in the mean is observed for Greece (EL), which grew by nearly 48 percentage points.[5] Six countries, Austria (AT), Czech Republic (CZ), Greece (HE), the Netherlands (NE), Slovakia (SK), and Spain (ES) registered mean growth of more than 20 percentage points. In many cases, the national mean masks large intra-country heterogeneity. For instance, in Austria, the coefficient of variation shows 1 SD (standard deviation) equals 91% of the mean.

The RTER is strongly correlated with the level of economic development. Table 3 shows the RTER at the start of the period by gross domestic product (GDP) quartiles. The regions with the lowest GDP (quartile 1) also exhibit the lowest TER at 29.47 on average. However, it should be noted that within these quartiles there is substantial variation, so the average picture clearly masks much underlying heterogeneity.

WHAT DRIVES THE CHANGE?

From the point of view of regional policy, it is vital to understand the extent to which the changes in the concentration of TE activities are driven by low RTER regions catching up, or whether they are reinforcing existing agglomerations. To test for this, we estimate an autoregressive model in logs, following an approach similar to that applied in the intergenerational income mobility literature (e.g., Blanden, Gregg, & Macmillan, 2007), which we interpret as a regional intertemporal persistence model:

$$\ln(y_1) = \alpha^n + \beta\ln(y_0) + \gamma\ln(C_k) + \mu \quad (2)$$

Table 2. Regional tertiary enrolment ratios (RTERs) by country in 2002 and 2012, ranked by difference.

		2002				2012				
Country	**Country code**	**Mean**	**SD**	**Frequency**	**CV**	**Mean**	**SD**	**Frequency**	**CV**	**Difference, 2002–12**
UK	UK	62	11.72	40	0.19	57.1	5.17	40	0.09	–4.9
Sweden	SE	74.2	13.00	8	0.18	69.7	12.42	8	0.18	–4.5
Latvia	LV	68.3	–	1	–	65.8	–	1	–	–2.5
Estonia	EE	62.7	–	1	–	66.2	–	1	–	3.5
Finland	FI	87.2			–	92.8	24.57	5	0.26	5.6
France	FR	50.8	11.82	25	0.23	57.4	9.82	22	0.17	6.6
Italy	IT	54.6	22.45	19	0.41	61.2	22.78	21	0.37	6.6
Luxembourg	LU	11.4	–	1	–	18.9	–	1	–	7.5
Germany	DE	45.4	12.40	38	0.27	55.1	9.21	38	0.17	9.7
Belgium	BE	57.1	32.03	11	0.56	68.5	34.08	11	0.50	11.4
Poland	PL	60.6	15.09	16	0.25	72.3	20.19	16	0.28	11.7
Romania	RO	32.8	23.71	8	0.72	44.5	40.47	8	0.91	11.7
Ireland	IE	54.1	11.95	2	0.22	68.1	20.22	2	0.30	14
Hungary	HU	45.3	19.71	7	0.44	59.6	22.98	7	0.39	14.3
Portugal	PT	51.6			–	67.4	27.77	7	0.41	15.8
Malta	MT	24.4	–	1	–	41.4	–	1	–	17
Denmark	DK	61.8			–	79.1	16.67	5	0.21	17.3
Cyprus	CY	26	–	1	–	44.2	–	1	–	18.2
Lithuania	LT	63	–	1	–	81.5	–	1	–	18.5
Slovenia	SI	65.7			–	84.4			–	18.7
Bulgaria	BG	40.2			–	59.9	29.01	6	0.48	19.7
Spain	ES	58.1	12.14	17	0.21	79.7	21.66	19	0.27	21.6
Netherlands	NL	53.3	24.71	12	0.46	75.6	13.53	12	0.18	22.3
Slovak Republic	SK	32.5	37.60	4	1.16	55.8	90.83	4	1.63	23.3
Austria	AT	46.4	41.99	9	0.91	70.8	44.23	9	0.62	24.4
Czech Republic	CZ	35.1	31.90	8	0.91	65.6	64.30	8	0.98	30.5
Greece	EL	64.3			–	112	46.78	4	0.42	47.7
Croatia	HR					56.5	4.10	2	0.07	56.5

Table 3. Regional tertiary enrolment ratio (RTER) 2002 by gross domestic product (GDP) quartile.

	Mean	SD	Frequency
GDP quartile 1	29.47	25.32	68
GDP quartile 2	35.67	21.97	66
GDP quartile 3	48.02	21.78	65
GDP quartile 4	51.17	29.99	66
Total	40.97	26.47	265

where $\ln(y_1)$ is the natural logarithm of the dependent variable, that is, the tertiary enrolment ratio in 2012; α^n is a group effect according to the country each region belongs to; $\beta\ln(y_0)$ is the persistence term showing the influence of the level of tertiary enrolment in 2002; and $\ln(C_k)$ is a vector of control variables specified as log of levels in the base period, that is, 2002.

Table 4 presents estimates of a simple version of this model, omitting country dummies. In our baseline specification we only include the persistence term and no controls. This shows a strong persistence effect, with approximately 55% of the level in 2012 being explained by the level of tertiary enrolment in 2002. In the second specification of this model, we control for the regional GDP and population density, but these are not statistically significant. In models (3) (a–d) we fit our baseline model separately, splitting it into four quartiles based on regional per capita GDP (purchasing power parity adjusted) in 2002. This partition of the main data set allows one to investigate whether the path-dependency affects all regions equally at different income levels.

These results reveal some heterogeneity in the way the persistence effect plays out. The persistence effect is strongest for the poorest and the richest regions, while the second-highest group by GDP (3) shows the lowest level of persistence. This group is composed almost entirely of regions within North Western Europe, typically second-tier regions outside capital regions and major commercial centres. This is consistent with previous findings, such as by Groen (2004) and Venhorst et al. (2011), that the availability of stronger job markets may influence the ability of regions to retain and to attract students but that this is counteracted by house prices

Table 4. Persistence model.

			Gross domestic product (GDP) quartile (3)			
Variables	**Baseline (1)**	**Full (2)**	**1st (a)**	**2nd (b)**	**3rd (c)**	**4th (d)**
RTER, ln, t0	0.553***	0.528***	0.709***	0.566***	0.273***	0.622***
	(0.0542)	(0.0587)	(0.0842)	(0.0707)	(0.0941)	(0.0946)
GDP, ln, t0		0.0549				
		(0.0521)				
Density, ln, t0		0.00559				
		(0.0217)				
Youth empl., ln, t0		−0.0678				
		(0.139)				
Constant	1.877***	1.704***	1.336***	1.777***	2.941***	1.636***
	(0.209)	(0.564)	(0.314)	(0.256)	(0.369)	(0.370)
Observations	227	204	46	52	61	57
R^2	0.565	0.562	0.698	0.579	0.297	0.623
R^2 adjusted	0.564	0.557	0.695	0.575	0.292	0.620

Notes: $*p < 0.10$, $**p < 0.05$, $***p < 0.010$.

Determinants of 2012 Regional Tertiary Enrolment Ratio. The dependent variable is the natural logarithm of the enrolment ratio in 2012. An observation is a NUTS-2 region in year *t*. Cluster-robust standard errors are shown in parentheses.

(Dotti et al., 2013). With the second fastest median GDP growth over the period, the regions in the second quartile are possibly those better positioned to free themselves from past their past path: the economic opportunities in those regions are still abundant, yet cost of living and other negativities present in the highest GDP regions are yet to unfold. These initial results suggest an inability among the poorest regions to catch up with the rest of the EU even with an average stronger GDP growth, and a generalized convergence among the wealthiest ones.

The TE sector in each region is embedded within the funding and regulatory framework of each member state and therefore likely to be influenced by national-level policies. For this reason, we rerun our models accounting for national-level group effects. Table 5 shows the results for the same models, this time including country dummies to capture the influence of group-wide shocks that are specific to each national TE system, and, more broadly, to each nation's economy. The baseline specification (model 1) is analogous to that observed previously, but when allowing for country dummies, the influence of persistence is stronger. Nationwide policy and economic shocks affect the relative success of regions within a European comparison, but once this is controlled for the intra-group component of the tertiary enrolment ratio is more strongly predicted by the past state. The overall variance explained by the model increases from 55.7% to 78.9%. On average, the level of TE enrolment in 2002 explains 67.1% of the enrolment in 2012.

In model 2, we control for GDP and population density. These two variables enable one to control for relative urbanization and economic performance of each region. Once we include country dummies, the regional GDP is found to explain around 26.5% of the level in 2012. When we partition the sample by GDP quartiles based on the values in 2002 (models (3a–3d)), the results qualitatively mirror our findings in the absence of countries dummies, with an increase in the coefficients. In model (3a), we see that for the poorest regions in the EU, more than the whole of the level in 2012 can be explained by the level in 2002. In other words, any change in the period is driven by national-level policy shocks, which effectively 'locked in' a path of lower TE growth. The second poorest regions also seem to follow a similar path, although

Table 5. Persistence model.

			Gross domestic product (GDP) quartile (3)			
Variables	**Baseline (1)**	**Full (2)**	**1st (a)**	**2nd (b)**	**3rd (c)**	**4th (d)**
RTER, ln, t0	0.671***	0.599***	1.008***	0.791***	0.327***	0.613***
	(0.0684)	(0.0771)	(0.0865)	(0.105)	(0.0939)	(0.104)
GDP, ln, t0		0.265**				
		(0.124)				
Density, ln, t0		0.00176				
		(0.0158)				
Youth employment, ln, t0		0.0751				
		(0.190)				
Constant	1.596***	−1.196	0.724**	1.140***	2.712***	1.792***
	(0.236)	(0.801)	(0.276)	(0.214)	(0.349)	(0.438)
Observations	227	204	46	52	61	57
R^2	0.777	0.801	0.872	0.900	0.727	0.905
Countries dummies	YES	YES	YES	YES	YES	YES
R^2 adjusted	0.766	0.789	0.854	0.889	0.703	0.894

Notes: *$p < 0.10$, **$p < 0.05$, ***$p < 0.010$.
Determinants of 2012 tertiary education enrolment with country dummies. The dependent variable is the natural logarithm of the enrolment ratio in 2012. An observation is a NUTS-2 region in year *t*. Cluster-robust standard errors are shown in parentheses.

Table 6. Relative change in tertiary education ratio.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
RTER t0	−0.0610***	−0.0662***	−0.0607***	−0.0593***	−0.0607***	−0.0651***	−0.0606***	−0.0604***	−0.0605***	−0.0655***	−0.0670***
	(0.0164)	(0.0193)	(0.0199)	(0.0179)	(0.0198)	(0.0172)	(0.0167)	(0.0161)	(0.0161)	(0.0198)	(0.0249)
RTER t0, (squared)	0.000399***	0.000446***	0.000393***	0.000386***	0.000396***	0.000422***	0.000396***	0.000387***	0.000388***	0.000426***	0.000433**
	(0.000125)	(0.000157)	(0.000147)	(0.000134)	(0.000146)	(0.000129)	(0.000126)	(0.000119)	(0.000119)	(0.000152)	(0.000180)
GDP RC		−0.0737								0.663***	1.266*
		(0.177)								(0.175)	(0.723)
Unemp. 15–24 RC			0.0915*								
			(0.0533)								
Unemp. 20–64 RC				0.131**						0.147*	−0.146
				(0.0661)						(0.0779)	(0.284)
Neet 18–24 RC					0.0877						
					(0.106)						
Life exp. RC						0.170				−0.121	−0.143
						(0.157)				(0.101)	(0.125)
Empl. 25–34 RC							−0.460				
							(0.396)				
Pop. dens. RC								1.402		1.354	3.471
								(0.959)		(1.430)	(2.951)
Pop. RC									1.425		
									(0.977)		
Constant	2.176***	2.331***	2.160***	2.097***	2.164***	2.330***	2.171***	2.133***	2.133***	2.074***	1.677***
	(0.500)	(0.594)	(0.598)	(0.533)	(0.597)	(0.528)	(0.507)	(0.476)	(0.474)	(0.564)	(0.455)
Observations	227	216	181	209	206	212	215	218	220	191	191
R^2	0.386	0.407	0.358	0.373	0.355	0.417	0.383	0.394	0.397	0.452	0.566
Countries Dummies	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
R^2 adjusted	0.383	0.403	0.353	0.369	0.351	0.413	0.379	0.390	0.392	0.443	0.536

Notes: *$p < 0.10$, **$p < 0.05$, ***$p < 0.010$.

The dependent variable is the relative change in the enrolment ration between 2002 and 2012. An observation is a NUTS-2 region in year t. Cluster-robust standard errors are shown in parentheses.

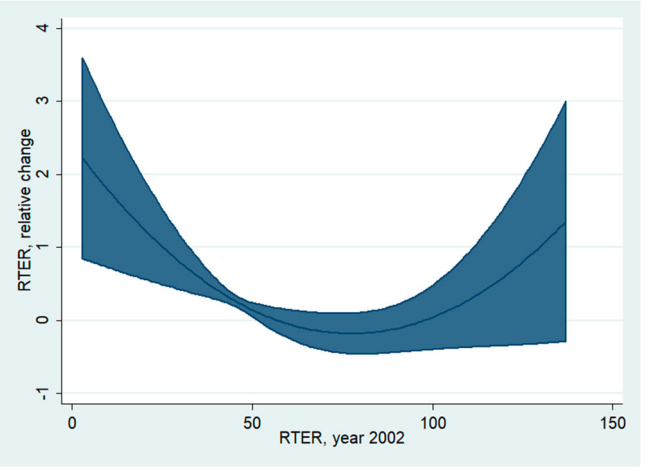

Figure 4. Simulated curve of relative change (all controls as in Table 6, (11)).

the persistence level is lower (79.1%). Overall, the size of the persistence effects increase for all GDP quartiles, except the richest one, which decreases marginally (−1.5%).

Change

The results from the previous section suggest a high level of path dependency, thus leading one to look deeper on the determinants of change in 2002–12.

We explore an alternative specification, modelling the percentage change in the RTER between 2002 and 2012. This alternative specification has the advantage to directly look into the change, rather than the levels, for the same period, 2002–12.

In order to analyse what drives the changes in the RTER, we specify the following model as:

$$\partial y = \alpha^n + \beta y_0 + \hat{\beta} y_0^2 + \gamma \delta C + \mu \tag{3}$$

where $\partial y = (y_{10} - y_0)/y_0$ is the relative change in the dependent variable from the start to the end of the period for each region r; α^n is a group effect according to the country each region belongs to; $\beta y_0 + \hat{\beta} y_0^2$ is a quadratic term to capture the influence of the initial level of the dependent variable on the rate of change; and $\gamma \delta C$ is a vector of covariates represented as relative change from the start to the end of our observations (i.e., between t_0 and t_{10}).

We fit several variants of this model, which are presented in Table 6. Model (1), our simplest model, only includes the level of the dependent variable at the start of the period and its squared term to account for non-linearity. In subsequent specifications of the model, we add a range of covariates. Model (3) suggests unemployment has a positive impact on TE growth, in line with previous research (e.g., Dadashova, Hossler, & Shapiro, 2011; Dellas & Sakellaris, 2003) while none of the other controls has a significant effect per se. However, when we control for the relative change in regional GDP, unemployment and life expectancy, we find positive and significant effect for the first two controls (10). All these results are in line with previous literature, especially in linking the goodness of regional job markets with attractiveness for students in TE (e.g., Groen, 2004). However, these covariates are weakly statistically significant and sensitive to the exact specification of the model so overall do not play a decisive role.

The influence of the initial level on growth rates is robust across all specifications (models 1–11). The quadratic term combines with the constant to form a 'U'-shaped curve where the influence of the initial starting point varies greatly across the level of the RTER. The predications of model (11) are simulated in Figure 4. We interpret this diagram as revealing a bifurcation of

results, where for the majority of regions, the rate of RTER growth declines as a higher level is reached, indicating convergence. Region's 1 range of 0–60% is catching up, exhibiting above average, whereas the growth in regions with RTERs of 60–100% have growth rates below average. However, the situation is more complex, as for those regions with RTER > 100% the growth is above average and increasing. In terms of overall numbers, these are only a few regions and could therefore be characterized as outliers, but, if taken at face value, it appears that for a small subset of regions, the usual pattern of saturation does not apply. This tendency is similar to that observed in recent findings on the dynamics of income (Alvaredo et al., 2018; Milanovic, 2013), and it further suggests that clusters of regions (sometimes termed 'clubs'; e.g., Borsi & Metiu, 2015)[6] tend to show similar behaviours based on their initial starting point and spatial aggregation, as partly found by von Lyncker and Thoennessen (2017).

It is clear that past performance is the single most important variable, with our baseline model result in a R^2 of 0.38. Once we include all covariates in model 10 this goes up to 0.44. Additionally, when we add country-level dummies in model (11), this rises to 0.54, suggesting that the national context matters, but this further alters the standard errors of the covariates affecting their statistical significance.

CONCLUSIONS

We have examined changes in the concentration of TE across European regions over a decade spanning 2002–12. This period was characterized by an overall rise in enrolment into TE, particularly among new member states of the EU, catching up from a low base. Moreover, this decade was marked by major economic shocks, mainly through the 2008 financial crisis and subsequent years of fiscal austerity, which have reduced public expenditures on higher education, and influenced the continent's job market (Prutvot et al., 2017).

Over this period, we observe path dependency, as the strongest predictor of the concentration of tertiary students in 2012, is the level in 2002. This result is in line with previous works highlighting patterns of unevenness and path dependency, and they further explain the uneven performance of institutions (Jöns & Hoyler, 2013; Paasi, 2005). When we model the rate of change in this period, we find that the economic characteristics of a region offer little explanatory power for the development of the TE sector, which are rather influenced by nation-level policies and their overall level of development. Regions near the mean of the distribution grow relatively slowly indicating saturation, but the most dramatic changes are happening at the tails of the distribution. Many regions with small sectors at the beginning of the period exhibit catch up growth and a few regions with a high share of TE activity show accelerating growth. Whilst outliers, it will be interesting to follow these highly successful TE regions over coming years to see if a bifurcated result persists, characterized by a few top performers and everyone else.

Reassuringly for regional policy-makers, it is possible to observe a high concentration of TE students in diverse regional circumstances. Unsurprisingly, many of these are rich and accessible capital regions, such as Vienna in Austria or Prague in the Czech Republic. However, we also see sparsely populated regions across Europe starting from a low base, and growing dramatically over this decade. The data show that building a new successful TE cluster is possible and policy-makers have a scope for promoting a more spatially equitable distribution of TE students.

This paper draws on the best data available for comprehensive analysis of TE in Europe. Unfortunately, this is not without limitations, leaving unresolved issues for future research. The EUROSTAT data are not fully comprehensive in terms of European regions as the full range of indicators used are not available for all regions. Some of the countries involved joined the EU only recently and therefore data are not available for all years. Moreover, the TE enrolment ratio does not distinguish between types of programmes (e.g., professional versus academic) in which students are enrolled. Similarly, no data are available for different types of TE activities,

for example, teaching and research, which are likely to impact the local economy differently. An implicit assumption in our analysis is that the number of students represents a proxy for the overall activity of the TE sector in the region. Future research will likely have to tackle at least some of these issues, and, when focussing on a subset of countries, use scales appropriate in relation to the decision-making processes of higher education institutions.

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NOTES

[1] A note on terminology: we adopt the term 'tertiary education' as this is consistent with available data that is comparable across the European Union. This, in turn, is derived from internationally accepted standards set out in UNESCO's ISCED (International Standard Classification of Education). Tertiary education in this sense refers to ISCED level 5 or above. This can include qualifications from universities and other higher education institutions, as well as advanced vocational qualifications. The exact delimitation between these institutional types varies across European countries and even regions (contrast, for instance, England and Scotland). However, comparable data are available for tertiary education in aggregate, which in practice includes higher education and some elements of further education.

[2] Siegfried, Sanderson, & McHenry (2007) discuss the vast grey literature on this topic and criticize how dubious methods are used to inflate impact for advocacy purposes.

[3] This was widely discussed in the press at the time (e.g. https://www.telegraph.co.uk/news/uknews/1502381/Crackdown-fails-to-stop-language-schools-visa-racket.html).

[4] Over the decade 2002–12, new countries have joined the EU, although the mobility of their nationals was not equally guaranteed by all other members. This, among other macro-policies, may have given other Western European EU members an advantage in attracting students from new members, particularly where language constraints were smaller.

[5] Notionally, Croatia (HR) exhibited a 56 percentage point growth, but data are not available to reveal the baseline in 2002. The data series for this country started in 2007.

[6] To avoid confusion, here clusters or clubs are meant as partitions of the data set based on quintiles, rather than clustering algorithms.

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